



DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 27 and 29

[Docket No.: FAA-2017-0990; Amdt. Nos. 27-51, 29-59]

RIN 2120-AK80

Normal and Transport Category Rotorcraft Certification

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Final rule.

SUMMARY: The FAA is amending the certification standards of normal and transport category rotorcraft. These changes are necessary to address modern designs currently used in the rotorcraft industry and will reduce the burden on applicants for certification of new rotorcraft designs. The changes will reduce or eliminate the need for certain special conditions currently required to obtain certification of modern rotorcraft. These changes also incorporate the provisions of equivalent level of safety findings and means of compliance issue papers that the FAA has made when approving certain design features.

DATES: Effective [INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: For information on where to obtain copies of rulemaking documents and other information related to this final rule, see “How To Obtain Additional Information” in the SUPPLEMENTARY INFORMATION section of this document.

FOR FURTHER INFORMATION CONTACT: For questions concerning this action, contact Sandra Shelley, Aviation Safety Engineer, Safety Management Group, FAA, 10101 Hillwood Pkwy, Fort Worth, TX 76177; telephone (817) 222-5110; email Sandra.Shelley@faa.gov.

SUPPLEMENTARY INFORMATION:

Authority for this Rulemaking

The FAA's authority to issue rules on aviation safety is found in title 49 of the United States Code. Subtitle I, section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

This rulemaking is promulgated under the authority described in Subtitle VII, part A, subpart III, sections 44701 and 44704. Under section 44701, the FAA is charged with prescribing regulations promoting safe flight of civil aircraft in air commerce by prescribing minimum standards required in the interest of safety for the design and performance of aircraft. Under section 44704, the Administrator issues type certificates for aircraft, aircraft engines, propellers, and specified appliances when the Administrator finds the product is properly designed and manufactured, performs properly, and meets the regulations and minimum standards prescribed under section 44701(a). This rulemaking is within the scope of these authorities because it promotes safety by updating the minimum prescribed standards used during the type certification process.

I. Overview of Final Rule

This final rule revises regulations in title 14 Code of Federal Regulations (14 CFR) part 27 (Airworthiness Standards: Normal Category Rotorcraft) and part 29 (Airworthiness Standards: Transport Category Rotorcraft) related to the certification of rotorcraft. These changes are necessary due to the extensive application of advancing technologies to rotorcraft. Current airworthiness standards do not adequately address increasing design complexity. To address these advances, the FAA has been issuing reoccurring special conditions, equivalent level of safety (ELOS) findings, and means of compliance (MOC) issue papers. This final rule addresses these areas by updating those standards that have been addressed by these special conditions, ELOS findings and MOC issue papers. Compliance with the regulatory changes implemented by this final rule will continue to be shown by the same testing, analysis, and inspections required by existing special conditions, ELOS findings and MOC issue papers. However, there will be a

reduced administrative burden, to both the rotorcraft industry and the FAA, through the reduction or elimination of reoccurring special conditions, ELOS findings, and MOC issue papers.

II. Background

A. Statement of the Problem

This final rule updates parts 27 and 29 because the regulations in these parts were originally published in 1964 and past revisions to the airworthiness standards have not kept pace with advances in technology for rotorcraft. The FAA addresses these changes to technology by issuing reoccurring special conditions, ELOS findings, and MOC issue papers. These three processes are necessary to address new design features for which airworthiness standards are lacking, compliance with a rule cannot be achieved, or alternative methods of compliance are proposed. Special conditions are prescribed under 14 CFR 21.16 when the FAA finds the applicable airworthiness standards do not contain adequate or appropriate safety standards because of a novel or unusual design feature. The FAA issues ELOS findings under § 21.21(b)(1) where a design does not comply with the airworthiness standards, but compensating factors exist that provide an equivalent level of safety. MOC issue papers document compliance methodologies that fall outside existing guidance and policies.

The process of developing, drafting and finalizing these special conditions, ELOS findings, and MOC issue papers has an impact on both the FAA's and the applicants' resources. In addition, they impact applicants' schedules for obtaining FAA approval of their products. By updating the affected standards, many of these special conditions, ELOS findings, and MOC issue papers are now unnecessary, thus reducing the burden on both the FAA and industry.

In some cases, advancements in technology have rendered the regulations in parts 27 and 29 obsolete. This final rule revises those regulations. This final rule also updates a few of these rules to correct typographical errors.

B. National Transportation Safety Board Recommendations

As a result of incidents involving smoke and fire caused by failure of lithium batteries installed on Boeing 787 aircraft, the National Transportation Safety Board (NTSB) issued Safety Recommendations A-14-032 through 036 to the FAA on May 22, 2014.¹ The NTSB recommended the FAA develop abuse tests to simulate failures observed in the incidents investigated and to address findings in recent research (A-14-032), perform these tests on new aircraft for certain installations (A-14-033), develop guidance on acceptable methods to induce thermal runaway that reliably simulates battery failures (A-14-034), review methods of compliance used to certificate in-service lithium-ion battery aircraft installations to ensure that they adequately protect against adverse effects of a cell thermal runaway (A-14-035), and develop policy to establish a panel of technical experts to advise on compliance and best practices for safely installing new technology (A-14-036). This final rule incorporates these NTSB recommendations as they relate to rotorcraft into §§ 27.1353 and 29.1353.

C. Summary of the NPRM

On November 1, 2017, the FAA published a notice of proposed rulemaking (NPRM), “Normal and Transport Category Rotorcraft Certification” (82 FR 50583). In the NPRM, the FAA proposed changes necessary to address modern designs currently used in the rotorcraft industry and to reduce the burden on applicants for certification of new rotorcraft designs. The FAA proposed changes that would reduce or eliminate the need for certain special conditions that were often required to obtain certification of modern rotorcraft. The FAA also proposed to incorporate the provisions of ELOS findings and MOC issue papers that the FAA has made when approving certain design features.

The comment period closed on January 30, 2018.

D. General Overview of Comments

The FAA received comments from 22 commenters. About half of the commenters were individuals. The remaining commenters included the NTSB, aviation manufacturers, industry

¹ <https://www.nts.gov/safety/safety-recs/recletters/A-14-032-036.pdf>

groups and organizations, and foreign civil aviation authorities. One commenter, the Aircraft Electronics Association, supported the proposed rule without change. Most commenters were generally supportive of the proposal but some suggested changes to the proposed rule, as discussed in more detail later in this preamble. Some comments were beyond the scope of the proposal.

III. Discussion of Public Comments and Final Rule

A. Engines (§ 27.903(d))

In the NPRM, the FAA proposed to reformat the paragraph designation in § 27.903(d) to be consistent with § 29.903(e). When § 27.903(d) was adopted, the paragraph designation of § 29.903(e) was not used even though the FAA intended the requirements to be identical. This designation led to confusion. This final rule eliminates the confusion by reformatting the paragraph designation in § 27.903(d) as proposed in the NPRM. The restart capability requirements of § 27.903(d) are not being changed in this rulemaking.

Bell Helicopter Textron, Inc. (Bell) and the General Aviation Manufacturers Association (GAMA) requested that part 27 appendix C be revised to remove the need for compliance with § 29.903(e), as the requirements are identical to proposed § 27.903(d). The FAA agrees and has removed the reference to § 29.903(e) from appendix C of part 27.

B. Powerplant instruments (§§ 27.1305 and 29.1305)

Current §§ 27.1305 and 29.1305 prescribe the specific required powerplant instruments for rotorcraft. The changes to these sections will allow for other means of compliance for certain powerplant instrument indicators. Additionally, for § 29.1305, the FAA will permit an optional feature to simulate one engine inoperative (OEI) conditions without damaging the engines. Rotorcraft with OEI Training Mode will require additional indications to differentiate the simulated OEI conditions from actual engine failure.

Airbus Helicopters requested that the FAA use different wording to describe a synthesized power indicator (SPI) for an instrument that provides a single indicator of

engine performance, because presenting the information as a percentage of power to the nearest engine limit is only one of the methods of informing the flightcrew.

The commenter's request did not pertain to the proposed regulatory text but rather to industry examples in the NPRM preamble. However, the guidance associated with this final rule, Advisory Circulars (AC) 27-1B, Certification of Normal Category Rotorcraft and AC 29-2C, Certification of Transport Category Rotorcraft, identifies other concepts of showing proximity to engine limits other than as a percentage.

Airbus Helicopters also commented that certification of SPIs can be accomplished using the existing rules, and provided examples of two designs that have been approved by the European Aviation Safety Agency (EASA). These technologies could only be certificated in the past by the FAA through processes such as that necessary for an ELOS finding. A key purpose of this rulemaking is to reduce or eliminate the need for reoccurring special conditions, ELOS findings, and MOC issue papers. Therefore, the FAA has made no changes to the regulatory text in response to this comment.

Bell, GAMA, Transport Canada, and an individual requested the FAA expand the changes to §§ 27.1305 and 29.1305 to allow synthesized dual/triple tachometers. This requested change is beyond the scope of the proposal. A key purpose of this rulemaking is to reduce or eliminate the need for reoccurring special conditions, ELOS findings, and MOC issue papers. The FAA has not issued any of these documents for synthesized dual or triple tachometers.

EASA requested that the FAA change the reference in the proposed § 27.1305(o) from engine "torque" to engine "power" to be consistent with § 29.1305(a)(16) and allowing for other forms of power determination. The requirement in § 27.1305(o) to display engine torque to the pilot is contingent on the establishment of a torque limitation for the engine under § 27.1521(e). Therefore, the requested change would create an

incompatibility between §§ 27.1305(o) and 27.1521(e). The FAA did not make any changes in response to this comment.

Transport Canada requested that the FAA correct a typographical error in the current § 27.1305(k)(2) and change “or” to “and.” Transport Canada noted that this correction would make the wording of § 27.1305(k)(2) identical to that section’s part 29 counterpart, § 29.1305(a)(14)(ii). The FAA notes that the word “or” in § 27.1305(k)(2) is not a typographical error. The difference in wording between § 27.1305(k)(2) and § 29.1305(a)(14)(ii) has existed in the Federal Aviation Regulations from the promulgation of parts 27 and 29 to replace the Civil Air Regulations.² Moreover, the requested change would increase the regulatory requirement. The FAA did not make any changes in response to this comment.

Transport Canada also requested the FAA change the wording in proposed § 29.1305(a)(5) from “a means to indicate manifold pressure for each reciprocation engine, of the altitude type” to “a means to indicate manifold pressure for each altitude engine” to align the reference to this type of reciprocating engine with references to this same engine type used throughout part 27. The FAA agrees and has made this change. Additionally, this change provides consistency with § 27.1305(e) and with the identification of this type of engine elsewhere in part 29, and the term “altitude engine” is as type of engine that is a reciprocating engine.

Bell, GAMA, and an individual proposed new language for § 27.1305 that would permit OEI training mode capability. OEI Training Mode is a design feature for Category A training purposes. As explained by the FAA in the NPRM, the FAA did not propose these changes because part 27 Category A rotorcraft are approved under appendix C to part 27, which requires compliance with § 29.1305. The FAA did not make any changes in response to these comments.

² 29 FR 15694 (Nov. 24, 1964); 29 FR 16148 (Dec. 3, 1964).

C. Rotorcraft Equipment, Systems, and Installations (§§ 27.1309, 29.1309, and Appendix C to Part 27)

Sections 27.1309 and 29.1309 require applicants to assess the effects of failures resulting from installed systems and equipment. The changes to § 27.1309 made by this final rule now address advances in technology and increases in performance of normal category rotorcraft that were not envisioned when the rule was originally promulgated, and eliminate the distinction between single-engine and multi-engine rotorcraft. The final rule broadens the scope of the previous performance-based requirement to include catastrophic failure conditions, thus eliminating the need for recurring special conditions. The final rule also more closely aligns with current industry practices and accommodates potential future changes in industry failure analysis techniques.

EASA requested the FAA reserve the paragraph numbering and allocate new paragraph numbers for the new regulatory text to avoid confusion between the proposed regulations and previous amendments. The FAA has determined that this requested change is impracticable as it would result in numerous regulatory paragraphs without content. Part 21 requires aviation manufacturers to be familiar with the airworthiness standards that are effective as the certification basis as of the date of their application for a type certificate. EASA also suggested designating the first paragraph under §§ 27.1309 and 29.1309 as “(a)” for clarity. The FAA did not add such a designation because the first two sentences of §§ 27.1309 and 29.1309 are generally applicable requirements.

Bell, GAMA, Robinson Helicopter Company (Robinson), and two individuals commented that the proposed changes to § 27.1309 would increase the amount of analysis necessary to show compliance for normal category rotorcraft. GAMA and Bell stated that the proposed changes would exceed what is required to address complex systems, eliminate the distinction between single and multi-engine rotorcraft, and fail to maintain sufficient distinction from § 29.1309. Bell and GAMA also expressed that an

increase in certification burden would be imposed by the changes, and be likely to cause significant economic damage to the rotorcraft industry. Similarly, Robinson stated that the proposed changes to § 27.1309 would significantly increase the regulatory burden on normal category rotorcraft by removing the distinction between single and multi-engine. According to Robinson, this would require additional failure analysis by the applicant, and alerting means in the design, resulting in a significant increase in the cost and complexity of small helicopters. Bell and GAMA requested that the proposed § 27.1309 be replaced with the recently promulgated § 23.2510, while Robinson requested that none of the proposed changes be made to § 27.1309.

This rulemaking does not change the current industry standard and compliance means for non-critical and noncomplex (simple) systems and equipment installed in normal category rotorcraft. As explained in the NPRM, the distinction between single and multi-engines no longer reflects the level of complexity of the systems installed in rotorcraft. Most applicants have been using industry standard methods, such as SAE/ARP 4761, for conducting their system safety analyses to show compliance with § 27.1309. These methods require assessment at the aircraft level regardless of whether the proposed design is a single or multi-engine configuration. As stated in the NPRM, the applicant's method for conducting the failure analysis remains the same. The changes eliminate the need for special conditions by incorporating prior special condition requirements for catastrophic and hazardous failure conditions into the rule text. The changes also provide a means for the integration of new technology into part 27 rotorcraft. A means of compliance for noncomplex (simple) systems is already provided in the guidance material for normal and transport category rotorcraft. Finally, the request to incorporate § 23.2510, a performance-based regulation contingent on the use of consensus standards, is beyond the scope of the NPRM.

Bell, GAMA, and Robinson commented that the changes to § 27.1309 eliminate an applicant's use of the FAA's safety continuum policy for part 27 rotorcraft. The FAA clarifies that the safety continuum policy, Policy No. PS-ASW-27-15, dated June 30, 2017,³ provides a tiered approach for compliance with § 27.1309, based upon the rotorcraft's weight, occupant capacity, and number and type of engines. This policy remains applicable as an option for any applicant. Under the policy, the certification rigor for simpler, less complex rotorcraft and systems differs from that which is necessary for more complex rotorcraft and systems to show compliance with § 27.1309.

EASA, Transport Canada, and an individual requested additional definition of the applicability of §§ 27.1309 and 29.1309. The commenters stated there will be confusion regarding whether to apply §§ 27.1309 and 29.1309 to systems outside of the current subpart. The FAA recognized the need to be clear about the applicability of the regulation; therefore, the proposed introductory text published in the NPRM for §§ 27.1309 and 29.1309 clarified that the rule would apply to any system or equipment whose failure has not been specifically addressed by another requirement in chapter I of title 14 of the CFR. The FAA has determined that the proposed regulatory text is adequately clear and has adopted it without change in this final rule.

EASA and Thales AVS France commented on the proposed ACs intended to provide acceptable means to comply with §§ 27.1309 and 29.1309. These commenters requested that the AC text providing that "the catastrophic failure condition should not result from a single failure" should be included in the regulation to resolve the inconsistency resulting from the inclusion of such language in the AC but not the regulatory text. The guidance materials provide analysis techniques for showing how an applicant can achieve "extremely improbable" in conjunction with a single failure. Single failures are not the only failure conditions that need to be addressed in order for the

³ <https://drs.faa.gov/browse/excelExternalWindow/0D4AF6EE7F3013848625815600705441.0001>

analysis to be complete. The FAA has clarified this in AC 27-1B and AC 29-2C, which provide acceptable means to comply with §§ 27.1309 and 29.1309.

Bell and GAMA requested the FAA not adopt the proposed requirement in §§ 27.1309(a) and 29.1309(a) for equipment, systems, and installations to be analyzed for hazards both individually and with regard to their integration with the rest of the aircraft. The commenters stated that the appropriate safety analysis methodologies for the equipment to be installed are already covered by paragraph (d) in §§ 27.1309 and 29.1309. The commenters stated the specific analysis is defined in guidance, and that including this statement in the regulation imposes a significant increase in the certification burden. This is incorrect. The requirement the commenters opposed for inclusion in paragraph (a) is already present in § 29.1309 and is included in special conditions for part 27 to certify proposed design features such as autopilot systems. In addition, this regulatory text does not dictate a specific analysis methodology to be used to show compliance; therefore, there is no increase in the certification burden.

GAMA, EASA, and Thales AVS France requested that the FAA change proposed §§ 27.1309(b) and 29.1309(b) to specify three levels of failure classification: catastrophic, hazardous, and major. In the NPRM, the FAA proposed a top level failure classification (catastrophic), a bottom level (minor), and any other level in between as long as the probability of the failure condition is inversely proportional to its consequences. EASA and GAMA stated that the proposed rule change would increase the regulatory burden by requiring the same analysis for minor failure conditions as for other, more severe failure conditions.

The FAA recognizes that proposed §§ 27.1309(b)(2) and 29.1309(b)(2) would have inadvertently raised the regulatory burden. That was not the FAA's intent, so in this final rule the FAA has revised §§ 27.1309(b)(2) and 29.1309(b)(2) to change the bottom

level failure classification to major, in order to maintain the current regulatory requirement.

The final rule provides flexibility for future changes in industry standards and practices by allowing as many levels of failure classification as an applicant wishes to propose, as long as the probability of the failure condition is inversely proportional to its consequences.

GAMA and an individual requested that the FAA make the language in §§ 27.1309(c) and 29.1309(c) consistent with one another, in that the word “and” is missing from § 27.1309(c). As explained in the NPRM, the FAA intended for these two sections to be consistent and thus, has corrected this error in this final rule such that “and” is included in § 27.1309(c), consistent with current § 29.1309(c).

Bell and GAMA commented on the FAA proposal to remove §§ 29.1309(b)(2) and 29.1309(e), which are specific to Category A rotorcraft, stating that these provisions are necessary companions to § 29.903(b) engine systems isolation requirements. The commenters stated that without a specific regulation for Category A systems and equipment, § 29.903(b) becomes the specific regulation and applies rather than § 29.1309. The commenters provided an example that, in order to show compliance with § 29.903(b), it would be necessary to show physical isolation between left engine and right engine indication systems, instead of providing integrated displays with redundancy rather than isolation with an appropriate probability for failure conditions that might affect both engine’s indications. The commenters are correct that § 29.903(b) is the specific regulation for Category A engine isolation requirements. However, the § 29.903(b) analysis is limited to systems required for engine operations. The commenters’ application of this analysis to engine indication systems and displays, which do not affect engine operation, is misplaced. Section 29.1309 requires applicants to assess the effects of failures resulting from installed systems and equipment, such as engine indicators or

displays that may be necessary for performing Category A operations. These requirements are unchanged by the proposals in the NPRM.

GAMA requested that proposed §§ 27.1309(d)(2) and 29.1309(d)(2), which require an analysis of “[t]he effect of multiple failures and latent failures,” be revised to preclude future interpretations of this paragraph as requiring consideration of multiple failures of unrelated functions or systems.

Although there are cases where the failures of unrelated functions or systems should be considered, the FAA shares the commenter’s concern on the need to limit multiple failure analysis so that every combination of failures of unrelated functions or systems will not need to be considered. The FAA has changed the guidance material, AC 27-1B and AC 29-2C, to provide guidance to help applicants determine the depth of analysis necessary when considering multiple failures in complying with §§ 27.1309(d)(2) and 29.1309(d)(2).

GAMA and Transport Canada requested that for the analysis of crew warning cues in proposed §§ 27.1309(d)(4) and 29.1309(d)(4), the FAA correct the word “warning.” In the NPRM, the FAA proposed to replace the term “warning” with “annunciation,” but in §§ 27.1309(d)(4) and 29.1309(d)(4) the term “warning” remained in the proposed regulatory text. However, Transport Canada suggested that “warning” be replaced with “alerting.”

The FAA has determined that the term “alerting” is generally understood to include warnings and cautions that may include aural and visual types of cues to the pilot as appropriate. The FAA agrees that “alerting” more accurately conveys the requirement, and so has included it in this final rule.

An individual requested the FAA address the additional costs that may be incurred by U.S. applicants seeking validation of type-certificated products by EASA.

The commenter states that the FAA's changes to §§ 27.1309 and 29.1309 compromise the rules' harmonization with EASA's rules.

The FAA's changes in this final rule incorporate the provisions of prior special conditions. EASA has validated several aircraft designs with the provisions of these special conditions. Therefore, the commenter's concern about additional costs during validation is not warranted.

D. Automatic pilot and flight guidance system (§§ 27.1329 and 29.1329)

In the NPRM, the FAA proposed to revise §§ 27.1329 and 29.1329 by combining the existing requirements for automatic pilot with those of §§ 27.1335 and 29.1335 for flight director systems into one rule for automatic pilot and flight guidance systems. EASA noted the FAA proposed to change the requirements in §§ 27.1329(a)(1) and 29.1329(a)(1) so that the system can be overpowered by "one pilot" to "the pilot" and in §§ 27.1329(a)(2) and 29.1329(a)(2) that the system can be disengaged by "each pilot" to "the pilot." EASA stated that these changes reduce the level of safety, as the prior rules required that the effort of one pilot be enough to overpower the system. The effect of the proposed language as described by EASA was not the FAA's intent. Accordingly, the final rule refers to "one pilot," in §§ 27.1329(a)(1) and 29.1329(a)(1) and "each pilot" in §§ 27.1329(a)(2) and 29.1329(a)(2) to be consistent with the existing regulatory requirement.

Transport Canada noted that the proposed rule appeared to include fly-by-wire in its definition of an automatic flight guidance and control system, and that manufacturers would not be able to comply with a requirement to completely disengage a fly-by-wire system. Transport Canada therefore requested the rule be changed so that a proposed design would only have to only disengage "any malfunctioning components of" the system.

The FAA did not intend for §§ 27.1329 and 29.1329 to cover flight control systems, including fly-by-wire. The section title and the introductory sentence have been changed in this final rule to remove references to “control.” Sections 27.1329(a)(2) and 29.1329(a)(2) have also been changed in this final rule so that applicants may design the system to either disengage the entire system, any malfunctioning component of the system, or both.

Bell, GAMA, Transport Canada, and Thales AVS France commented that the proposed §§ 27.1329(d) and 29.1329(d) would have eliminated the condition of “assuming that corrective action begins within a reasonable period of time.” The commenters stated that the FAA did not explain the elimination of this statement.

The existing text identified by commenters was inadvertently omitted from the NPRM, but is included in this final rule.

E. Instrument Systems (§ 29.1333 and Appendix B to Parts 27 and 29)

Current § 29.1333(a) requires isolating the pilot instrument system from any other operating systems because at the time the rule was promulgated, these systems were federated, and connecting the systems increased the likelihood that a fault in one system could cause a failure in the pilot instrument system. In the NPRM, the FAA proposed to revise § 29.1333(a) and section VIII(b)(5)(i) of appendix B to parts 27 and 29 limiting it to pneumatic systems, allowing for the use of current technology to display integrated information to the pilot.

Airbus Helicopters requested that the FAA change the word “system” to “parts” so that the requirement for physical independence only applies to the pneumatic parts of a system.

The FAA intended for only the pneumatic portion of the system to have physical independence. The FAA is not changing the proposed rule text as suggested by the commenter because the word “parts,” could be interpreted as a component as opposed to

only the pneumatic portion of the system. This section of the rule is adopted as proposed in the NPRM.

F. Energy Storage System (§§ 27.1353 and 29.1353)

The FAA's current regulations pertaining to batteries for rotorcraft include requirements specific to lead-acid batteries and nickel-cadmium batteries. In the NPRM, the FAA proposed performance-based requirements to accommodate any energy storage system. As a result, this final rule incorporates, for rotorcraft, the NTSB's recommendation that the FAA require aircraft manufacturers to demonstrate acceptable performance as part of the certification of any new aircraft design that incorporates the installation of lithium-ion batteries.

Bell and GAMA requested that the FAA modify proposed §§ 27.1353(a) and 29.1353(a) by removing the word "automatic" from the protective design features required for hazard mitigation, and expressed concern that a requirement that the features be "automatic" would increase certification requirements. Current §§ 27.1353(g) and 29.1353(c) contain a similar requirement for automatic features to monitor the battery system for nickel-cadmium batteries and prevent or mitigate an over temperature condition or battery failure. Special conditions issued by the FAA to certificate lithium battery installations have required automatic features to monitor the battery system and protect the aircraft. The proposed regulation does not change this requirement but rather incorporates it into a rule that accommodates any energy storage system. Some energy storage system hazards may occur too rapidly to be mitigated by pilot action; therefore, automatic monitoring and control is necessary which would not increase certification requirements.

In another comment, the NTSB suggested including more prescriptive language in §§ 27.1353(a) and 29.1353(a) to address all possible mitigation strategies. By using performance-based requirements, this final rule allows both current and future mitigation

strategies. A prescriptive list of current acceptable mitigation strategies may not allow for future energy storage technologies. Accordingly, in this final rule, the FAA has adopted §§ 27.1353(a) and 29.1353(a) as proposed.

Bell and GAMA requested modifying proposed §§ 27.1353(b) and 29.1353(b), because they would have required venting as the means of limiting the accumulation of hazardous gases, fluids, and smoke. The FAA agrees with these comments and has adopted Bell and GAMA's recommended language in this final rule, in order to allow other types of hazard mitigation. The intent of the rule is to require that emissions not accumulate in hazardous (flammability, toxicity, visibility, etc.) quantities. Designs may accomplish this through venting or through other means.

Bell and GAMA commented that the term "damage" in §§ 27.1353(c) and 29.1353(c) is unclear and requested that the rule be revised from "must not damage surrounding structures, adjacent equipment, or systems necessary for continued safe flight and landing" to "must not result in any hazardous effect on structures, equipment, or systems necessary for continued safe flight and landing." The language proposed in the NPRM was retained from the current rule and accurately captures the requirement. The commenter's suggested change would allow damage to occur undetected until it evolved into a hazardous condition, which was not the intent of the rule. Accordingly, in this final rule, the FAA has adopted §§ 27.1353(c) and 29.1353(c) as proposed.

The NTSB requested that proposed §§ 27.1353(d) and 29.1353(d) be revised to address the maximum amount of pressure from an energy storage system failure. The FAA agrees, since a rapid increase in pressure that exceeds the maximum amount for an energy storage system that is not contained may result in damage to surrounding systems or structure. Proposed §§ 27.1353(d) and 29.1353(d) have been revised consistent with the NTSB comment.

GAMA commented that the §§ 27.1353(e) and 29.1353(e) requirement to provide a means to monitor and inform the pilot of energy storage system health precludes other mitigating design features and may be unnecessary when effective containment measures are used. GAMA requested adding an alternative requirement to allow sufficient containment of the energy storage system.

GAMA's requested change to §§ 27.1353(e) and 29.1353(e) would invalidate the requirement that the pilot be notified of all critical system parameters. The pilot must know the health of the required energy storage system. The regulation does not preclude other mitigating strategies but these must include a means for the pilot to know the condition of all critical system parameters. Accordingly, in this final rule, the FAA has adopted §§ 27.1353(e) and 29.1353(e) as proposed.

G. Airspeed indicator (§ 27.1545)

Current § 27.1545 requires instruments to be marked with a green arc and red radial lines. In the NPRM, the FAA proposed to remove the restrictive requirement for some instrument markings to allow alternative means of compliance.

Bell and GAMA requested the rule specify when V_{NE} must be displayed, allow provisions for variable V_{NE} information, and clarify that a V_{NE} caution range is not always applicable. These requested changes are beyond the scope of this rulemaking, which was to make the color and depiction of the airspeed indicator markings less prescriptive. In addition, the suggested wording would be more prescriptive, and therefore restrict traditional systems from being approved.

An individual requested the FAA change the term "yellow arc" in § 27.1545(b)(3) to "amber arc" to be consistent with § 27.1322(b). The requested change is beyond the scope of this rulemaking, which was to eliminate the need for reoccurring MOC issue papers for a lack of green arc in modern electronic displays. The FAA has not created any issue papers because of the requirement for a "yellow" arc.

H. Powerplant instruments (§ 27.1549)

The current regulation requires instruments to be marked with a green arc and red radial lines. In the NPRM, the FAA proposed to remove these requirements for some instrument markings.

EASA suggested the term “radial” in §§ 27.1549(a) and 29.1549(a) be replaced with “range,” similar to the proposed §§ 27.1549(d) and 29.1549(d). Sections 27.1549(a) and 29.1549(a) specify the requirement for marking of maximum and minimum safe operating limits. A red line is a defined limit. A range, in this context, would allow a level of ambiguity in the marking of the indicator. The FAA did not make any changes in response to the comment.

Transport Canada requested that the term “marked” be changed to “displayed” throughout §§ 27.1549 and 29.1549. The term “marked” is more consistent with the other instrument regulations for rotorcraft and airplanes. The FAA did not make any changes in response to the comment.

An individual requested the FAA change the term “yellow arc” in §§ 27.1549(b)(3) and 29.1549(c) to “amber arc” to be consistent with § 27.1322(b). The requested change is beyond the scope of this rulemaking, which was to eliminate the need for reoccurring MOC issue papers for a lack of green arc in modern electronic displays. The FAA has not created any issue papers because of the requirement for a “yellow” arc.

Bell and GAMA requested that the word “propeller” be changed to “rotor” in §§ 27.1549(d) and 29.1549(d). The word “propeller” comes from a prior rule amendment to parts 27 and 29 that was based on a part 25 rule. Although “propeller” is an appropriate term for airplanes, “rotor” is the more appropriate term for rotorcraft. The FAA agrees and has made the requested change.

One commenter noted the typographical omission of the word “and” between the proposed §§ 27.1549(d) and 27.1549(e). The FAA has corrected this error in this final rule by including “and” at the end of paragraph (d), consistent with the current rule.

I. Control Marking (§§ 27.1555 and 29.1555)

The control marking regulations required marking the usable fuel capacity at the fuel quantity indicator. The intent of these regulations was to provide a continuous indication of usable fuel capacity at the fuel quantity indicator. Older, analog gauges used a placard to comply with this requirement. In the NPRM, the FAA proposed performance-based requirements to permit other means of informing the pilot of the usable fuel system capacity. However, this final rule requires that alternative methods address any lack of continuous display by ensuring the information is readily accessible to the pilot.

Bell and GAMA requested modifying proposed §§ 27.1555(c)(1) and 29.1555(c)(1) to require “a means to provide the usable fuel capacity to the pilot.” The intent of the language proposed in the NPRM was to keep the existing requirement for applicants that choose to follow that method, while providing an additional, less prescriptive method.

Similarly, EASA requested the FAA make the requirement more generic by eliminating the reference “to the pilot” within §§ 27.1555(c)(1)(i) and 29.1555(c)(1)(i), since this information is also used during maintenance and servicing. However, removing the requirement that the information be accessible to the pilot would not ensure that the pilot always has access to the data, which is the purpose of this rule.

GAMA also requested modifying §§ 27.1555(c)(2) and 29.1555(c)(2), which contains usable fuel capacity requirements for fuel systems with selector controls, to match the proposed language in §§ 27.1555(c)(1) and 29.1555(c)(1) for fuel systems with no selector controls. The changes in the NPRM were proposed to eliminate the issues

associated with placarding a digital display in a modern glass cockpit. Placarding near or at the selector switches does not create these issues.

Additionally, GAMA requested that the FAA update §§ 27.1583(b)(3) and 29.1583(b)(3) to require that the flight manual include the usable fuel capacity information required per §§ 27.1555(c)(1) and 29.1555(c)(1) respectively. This requested change is not appropriate, because the requirement to add the capacity information into the flight manual is only necessary if it is not continuously displayed at the indicator. The commenter's requested language would require the information in the flight manual for all designs.

Airbus Helicopters requested that the FAA clarify whether "usable fuel capacity" refers to the actual remaining fuel or to the total usable capacity of the fuel system. The FAA notes that the term "usable fuel capacity" refers to the total usable capacity of the fuel system. The requirements for indicating the actual usable quantity are contained within §§ 27.1305, 27.1337, 29.1305, and 29.1337. In the NPRM, the FAA did not propose modifying the language or meaning of "usable fuel capacity." Changing the meaning is outside the scope of this rulemaking. The proposed rule language provides an alternative, less prescriptive requirement allowing the applicant to relay the fuel system capacity to the crew by means other than a placard at the fuel quantity indicator.

J. Undue Burden on Industry

In the NPRM preamble, the FAA stated that this rulemaking would update several rules that cause unnecessary burdens in cost and time to both the FAA and the rotorcraft industry. These changes are necessary due to the extensive application of advancing technologies to rotorcraft, which the airworthiness standards did not adequately address. The FAA proposed that, by updating the affected standards, many special conditions, ELOS findings, and MOC issue papers would become unnecessary, thus reducing the burden of cost and time on the FAA and industry.

GAMA requested rewording or deleting “reduced burden for the rotorcraft industry,” because showing compliance by the same testing analysis and inspections strongly implies there is no reduced burden. Additionally, GAMA requested that the FAA perform an analysis of the economic impact of the regulatory changes on small entities and provide access to the results of such analysis in the proposed rulemaking.

This rule updates parts 27 and 29 to address changes in technology and to include updated airworthiness standards. The FAA maintains that while compliance is shown by the same testing, analysis, and inspections, there will be savings to both the FAA and industry from updating the airworthiness standards. Updating the airworthiness standards reduces the number of reoccurring special conditions, ELOS findings, and MOC issue papers and the administration burden associated with processing one of the three documents.

Further information regarding final rule revisions that address comments on this issue is provided in discussions, C. Rotorcraft Equipment, Systems, and Installations (§§ 27.1309, 29.1309, and Appendix C to Part 27) and F. Energy Storage System (§§ 27.1353 and 29.1353). Additionally, the FAA has complied with the Regulatory Flexibility Act for this rulemaking and certified that a regulatory flexibility analysis is not required, as this rule will not have a significant economic impact on a substantial number of small entities.

K. Other Comments

One individual requested guidance for installing antennas on helicopters for both part 27 and 29. Two other individuals requested the FAA adopt rules to address accident rates, such as adding § 25.1302 to parts 27 and 29 and implementing Terrain Awareness and Warning Systems and Radar Altimeters. Another individual provided comments about minimum backup systems for VFR-only rotorcraft. The FAA appreciates the

interest in aviation safety from these commenters; however, these comments were beyond the scope of this rulemaking effort.

IV. Regulatory Notices and Analyses

A. Regulatory Evaluation

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 and Executive Order 13563 direct that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Public Law 96-354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Public Law 96-39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, the Trade Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 (Public Law 104-4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of \$100 million or more annually (adjusted for inflation with base year of 1995). This portion of the preamble summarizes the FAA's analysis of the economic impacts of this final rule.

This final rule revises regulations in 14 CFR part 27 (Airworthiness Standards: Normal Category Rotorcraft) and part 29 (Airworthiness Standards: Transport Category Rotorcraft) related to the certification of rotorcraft. The changes are necessary because the airworthiness standards did not adequately address the increases in design complexity resulting from advancing technologies. As a result, many regulatory sections have been subject to reoccurring special conditions, ELOS findings, and MOC issue papers. This rulemaking addresses these items by

updating the rules that cause unnecessary burdens in cost and time to both the rotorcraft industry and the FAA.

The FAA received comments on the NPRM that was published on November 1, 2017. The comments and the FAA's response to them are discussed in "III. Discussion of Public Comments and Final Rule," in the preamble to this final rule. The FAA made changes to the proposed rule as a result of the public comments. However, the changes assisted the FAA in clarifying and updating the proposal to ensure there will not be additional costs from this rulemaking. These changes did not result in additional costs to industry or the FAA. The FAA expects this rule will not result in additional costs to industry since it incorporates current industry practice. In addition, the rule will provide small savings to industry and the FAA by avoiding the burden and costs associated with developing special conditions, ELOS findings and MOC issue papers. The rule affects U.S. manufacturers of normal and transport category rotorcraft plus any rotorcraft operator or owner who applies for a supplemental type certificate (STC). The remainder of this section provides discussion of the impact and savings of this final rule by topic.

1. Powerplant Instruments (§§ 27.1305 and 29.1305)

Changes to these sections will allow for other means of compliance for certain powerplant instrument indicators. These means of compliance are voluntary and do not impose any new cost but could be cost relieving for applicants that choose to use them. Additionally, for § 29.1305, the FAA will permit an optional feature to simulate OEI conditions without damaging the engines. Rotorcraft with OEI Training Mode must have additional indications to differentiate the simulated OEI condition from actual engine failure. The OEI Training Mode is often installed in modern multi-engine rotorcraft. The FAA finds that this change will not result in additional costs to industry. The OEI Training Mode is optional and this change removes the need to issue special conditions for those manufacturers or modifiers including OEI training modes in their rotorcraft.

2. Normal Category Rotorcraft Equipment, Systems, and Installations (§ 27.1309 and Appendix C to Part 27)

The FAA revises the failure analysis requirement for equipment, systems, and installations to reduce the need for special conditions. These changes more closely align with current industry practices and also accommodate future changes in industry failure analysis techniques. Additionally, the FAA eliminates the distinction between single-engine and multi-engine rotorcraft. This distinction is no longer relevant because current analysis tools for technologies and associated failure effects no longer consider the number of engines. This will reduce the need to issue recurring special conditions, potentially providing small savings for manufacturers and anybody who modifies the rotorcraft. As these are current industry practice, the FAA finds there are no additional costs associated with these changes.

3. Transport Category Rotorcraft Equipment, Systems, and Installation (§ 29.1309)

This section is updated to be consistent with industry standards and practices for conducting failure analysis. The rule clarifies the requirement to perform a failure analysis and recognizes that the severity of failures can vary. Additionally, this section accommodates future changes in industry failure analysis techniques and reflects current certification practices. The rule allows for other options that will reduce the need to issue recurring special conditions, potentially providing small savings for manufacturers and applicants looking to modify a rotorcraft.

4. Automatic Pilot and Flight Guidance Systems (§§ 27.1329, 27.1335, 29.1329, and 29.1335)

This rule standardizes terminology and combines the requirements for automatic pilot and flight director systems into one rule. Modern designs combine both automatic pilot and flight director systems and are now referred to as automatic pilot and flight guidance systems.

5. Instrument Systems (§ 29.1333 and Appendix B to Parts 27 and 29)

The change allows for the use of more modern integrated systems to monitor and display highly integrated information regarding the rotorcraft. This section does not impose additional costs as the updates reflect modern industry practices of integrating instrument systems.

6. Electrical Systems and Equipment (§ 29.1351) and Energy Storage Systems (§§ 27.1353 and 29.1353)

The changes accommodate different energy storage systems. The regulation applies to lead acid, nickel-cadmium, and lithium batteries without imposing additional requirements. The changes will provide the flexibility necessary for the regulations to keep up with changes in technology.

7. Instrument Markings (§§ 27.1545, 29.1545, 27.1549, and 29.1549)

The final rule provides flexibility for some instrument markings. Allowing for other markings will not result in additional mandatory costs and may be possibly cost relieving for manufacturers that elect to outfit the rotorcraft with different instrument markings.

8. Control Markings (§§ 27.1555 and 29.1555)

The rule permits more than one method to inform the pilot of the usable fuel system capacity. However, alternative methods must address the lack of continuous display currently required. Changes to this section allow for more than one means of compliance at no additional costs. Offering alternative means of compliance allows industry to meet the requirement with the least costly option, which can be cost relieving.

9. Typographical and Standardizing Corrections (§§ 27.87, 27.903, 29.955, 29.977, 29.1019, 29.1517, and 29.1587)

There are no additional costs for changes to these sections as these are typographical or standardizing corrections.

Based on the discussion above, the FAA has determined that this final rule is not a “significant regulatory action” as defined in section 3(f) of Executive Order 12866.

B. Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (Public Law 96-354) (RFA) establishes “as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration.” The RFA covers a wide range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA. However, if an agency determines that a rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the RFA provides that the head of the agency may so certify and a regulatory flexibility analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear.

This final rule amends the certification standards of normal and transport category rotorcraft to incorporate modern designs currently used in the rotorcraft industry. Currently, changes in technology are addressed by issuing reoccurring special conditions, ELOS findings, and MOC issue papers. These three processes are necessary to address new design features for which airworthiness standards are lacking, compliance with a rule cannot be achieved, or alternative methods of compliance are proposed. These special conditions, ELOS findings, and MOC issue papers impact FAA and industry resources as well as applicants’ schedules for obtaining FAA approval of their products. By updating the affected standards with this final rule, many special conditions, ELOS findings, and MOC issue papers will become unnecessary, thus

reducing both the FAA and industry's administration burden associated with processing one of the three documents.

As the rule reduces the administrative burden and does not include any new regulatory burden, the FAA expects this rule will not result in additional costs and may result in small cost savings for any small entity affected by this rulemaking action. If an agency determines that a rulemaking will not result in a significant economic impact on a substantial number of small entities, the head of the agency may so certify under section 605(b) of the RFA. Therefore, as provided in section 605(b), the head of the FAA certifies that this rulemaking will not result in a significant economic impact on a substantial number of small entities.

C. International Trade Impact Assessment

The Trade Agreements Act of 1979 (Public Law 96-39), as amended by the Uruguay Round Agreements Act (Public Law 103-465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such as the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards.

The FAA has assessed the potential effect of this final rule and determined that the potential benefits are available to both domestic and international firms, which would either have no effect or a positive effect on international trade.

D. Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Public Law 104-4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of \$100 million or more (in 1995

dollars) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a “significant regulatory action.” The FAA currently uses an inflation-adjusted value of \$155 million in lieu of \$100 million.

This final rule does not contain such a mandate; therefore, the requirements of Title II of the Act do not apply.

E. Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. The FAA has determined that there would be no new requirement for information collection associated with this final rule.

F. International Compatibility and Cooperation

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to conform to International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that there are no ICAO Standards and Recommended Practices that correspond to these final regulations.

G. Environmental Analysis

FAA Order 1050.1F identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this rulemaking action qualifies for the categorical exclusion identified in paragraph 5-6.6.f and involves no extraordinary circumstances.

V. Executive Order Determinations

A. Executive Order 13132, Federalism

The FAA has analyzed this rule under the principles and criteria of Executive Order 13132, Federalism. The agency has determined that this action will not have a substantial direct effect on the States, or the relationship between the Federal Government and the States, or on the

distribution of power and responsibilities among the various levels of government, and, therefore, would not have Federalism implications.

B. Executive Order 13211, Regulations that Significantly Affect Energy Supply, Distribution, or Use

The FAA analyzed this rule under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). The agency has determined that it will not be a “significant energy action” under the executive order and will not be likely to have a significant adverse effect on the supply, distribution, or use of energy.

VI. How To Obtain Additional Information

A. Rulemaking Documents

An electronic copy of a rulemaking document may be obtained from the internet by—

1. Searching the Federal eRulemaking Portal (www.regulations.gov);
2. Visiting the FAA’s Regulations and Policies web page at

www.faa.gov/regulations_policies/; or

3. Accessing the Government Printing Office’s web page at www.GovInfo.gov.

Copies may also be obtained by sending a request (identified by notice, amendment, or docket number of this rulemaking) to the Federal Aviation Administration, Office of Rulemaking, ARM-1, 800 Independence Avenue SW, Washington, DC 20591, or by calling (202) 267-9680.

B. Comments Submitted to the Docket

Comments received may be viewed by going to <https://www.regulations.gov> and following the online instructions to search the docket number for this action. Anyone is able to search the electronic form of all comments received into any of the FAA’s dockets by the name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.).

C. Small Business Regulatory Enforcement Fairness Act

The Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996 requires FAA to comply with small entity requests for information or advice about compliance with statutes and regulations within its jurisdiction. A small entity with questions regarding this document, may contact its local FAA official, or the person listed under the FOR FURTHER INFORMATION CONTACT heading at the beginning of the preamble. To find out more about SBREFA on the Internet, visit https://www.faa.gov/regulations_policies/rulemaking/sbre_act/.

List of Subjects

14 CFR Part 27

Aircraft, Aviation safety.

14 CFR Part 29

Aircraft, Aviation safety.

The Amendments

In consideration of the foregoing, the Federal Aviation Administration amends chapter I of title 14, Code of Federal Regulations (CFR) parts 27 and 29 as follows:

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

1. The authority citation for part 27 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701-44702, 44704.

2. Amend § 27.87 by revising the section heading and paragraph (a) introductory text to read as follows:

§ 27.87 Height-velocity envelope.

(a) If there is any combination of height and forward velocity (including hover) under which a safe landing cannot be made under the applicable power failure condition in paragraph (b) of this section, a limiting height-velocity envelope must be established (including all pertinent information) for that condition, throughout the ranges of—

* * * * *

3. Amend § 27.903 by revising paragraph (d) to read as follows:

§ 27.903 Engines.

* * * * *

(d) *Restart capability.* (1) A means to restart any engine in flight must be provided.

(2) Except for the in-flight shutdown of all engines, engine restart capability must be demonstrated throughout a flight envelope for the rotorcraft.

(3) Following the in-flight shutdown of all engines, in-flight engine restart capability must be provided.

4. Amend § 27.1305 by revising paragraphs (e), (k) introductory text, (n), and (o) to read as follows:

§ 27.1305 Powerplant instruments.

* * * * *

(e) A means to indicate manifold pressure for each altitude engine.

* * * * *

(k) A means to indicate the r.p.m. of each engine and at least one tachometer, as applicable, for:

* * * * *

(n) A means to indicate the gas temperature for each turbine engine.

(o) A means to enable the pilot to determine the torque of each turbine engine, if a torque limitation is established for that engine under § 27.1521(e).

* * * * *

5. Revise § 27.1309 to read as follows:

§ 27.1309 Equipment, systems, and installations.

The equipment, systems, and installations whose functioning is required by this subchapter must be designed and installed to ensure that they perform their intended functions under any foreseeable operating condition. For any item of equipment or system whose failure

has not been specifically addressed by another requirement in this chapter, the following requirements also apply:

(a) The design of each item of equipment, system, and installation must be analyzed separately and in relation to other rotorcraft systems and installations to determine and identify any failure that would affect the capability of the rotorcraft or the ability of the crew to perform their duties in all operating conditions.

(b) Each item of equipment, system, and installation must be designed and installed so that:

- (1) The occurrence of any catastrophic failure condition is extremely improbable;
- (2) The occurrence of any major failure condition is no more than improbable; and
- (3) For the occurrence of any other failure condition between major and catastrophic, the probability of the failure condition must be inversely proportional to its consequences.

(c) A means to alert the crew in the event of a failure must be provided when an unsafe system operating condition exists and to enable them to take corrective action. Systems, controls, and associated monitoring and crew alerting means must be designed to minimize crew errors that could create additional hazards.

(d) Compliance with the requirements of this section must be shown by analysis and, where necessary, by ground, flight, or simulator tests. The analysis must account for:

- (1) Possible modes of failure, including malfunctions and misleading data and input from external sources;
- (2) The effect of multiple failures and latent failures;
- (3) The resulting effects on the rotorcraft and occupants, considering the stage of flight and operating conditions; and
- (4) The crew alerting cues and the corrective action required.

6. Amend § 27.1329 by revising the section heading, adding introductory text, and revising paragraphs (a), (d), and (e) to read as follows:

§ 27.1329 Automatic pilot and flight guidance system.

For the purpose of this subpart, an automatic pilot and flight guidance system may consist of an autopilot, flight director, or a component that interacts with stability augmentation or trim.

(a) Each automatic pilot and flight guidance system must be designed so that it:

(1) Can be overpowered by one pilot to allow control of the rotorcraft;

(2) Provides a means to disengage the system, or any malfunctioning component of the system, by each pilot to prevent it from interfering with the control of the rotorcraft; and

(3) Provides a means to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.

* * * * *

(d) The system must be designed so that, within the range of adjustment available to the pilot, it cannot produce hazardous loads on the rotorcraft, or create hazardous deviations in the flight path, under any flight condition appropriate to its use or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(e) If the automatic pilot and flight guidance system integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be a means to prevent improper operation.

* * * * *

§ 27.1335 [Removed]

7. Remove § 27.1335.

8. Revise § 27.1353 to read as follows:

§ 27.1353 Energy storage systems.

Energy storage systems must be designed and installed as follows:

(a) Energy storage systems must provide automatic protective features for any conditions that could prevent continued safe flight and landing.

(b) Energy storage systems must not emit any flammable, explosive, or toxic gases, smoke, or fluids that could accumulate in hazardous quantities within the rotorcraft.

(c) Corrosive fluids or gases that escape from the system must not damage surrounding structures, adjacent equipment, or systems necessary for continued safe flight and landing.

(d) The maximum amount of heat and pressure that can be generated during any operation or under any failure condition of the energy storage system or its individual components must not result in any hazardous effect on rotorcraft structure, equipment, or systems necessary for continued safe flight and landing.

(e) Energy storage system installations required for continued safe flight and landing of the rotorcraft must have monitoring features and a means to indicate to the pilot the status of all critical system parameters.

9. Amend § 27.1545 by revising paragraph (b) to read as follows:

§ 27.1545 Airspeed indicator.

* * * * *

(b) The following markings must be made:

(1) A red line—

(i) For rotorcraft other than helicopters, at V_{NE} .

(ii) For helicopters, at V_{NE} (power-on).

(iii) For helicopters, at V_{NE} (power-off). If V_{NE} (power-off) is less than V_{NE} (power-on) and both are simultaneously displayed, the red line at V_{NE} (power-off) must be clearly distinguishable from the red line at V_{NE} (power-on).

(2) [Reserved]

(3) For the caution range, a yellow range.

(4) For the normal operating range, a green or unmarked range.

* * * * *

10. Amend § 27.1549 by revising paragraphs (a) through (d) to read as follows:

§ 27.1549 Powerplant instruments.

* * * * *

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red line;

(b) Each normal operating range must be marked as a green or unmarked range;

(c) Each takeoff and precautionary range must be marked with a yellow range or yellow line;

(d) Each engine or rotor range that is restricted because of excessive vibration stresses must be marked with red ranges or red lines; and

* * * * *

11. Amend § 27.1555 by revising paragraph (c)(1) to read as follows:

§ 27.1555 Control markings.

* * * * *

(c) * * *

(1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator unless it is:

(i) Provided by another system or equipment readily accessible to the pilot; and

(ii) Contained in the limitations section of the rotorcraft flight manual.

* * * * *

12. Amend § 27.1587 by revising paragraph (a)(1) to read as follows:

§ 27.1587 Performance information.

(a) * * *

(1) Enough information to determine the limiting height-velocity envelope.

* * * * *

13. Amend appendix B to part 27 by revising paragraphs VIII introductory text and VIII(b)(5)(i) to read as follows:

Appendix B to Part 27-- Airworthiness Criteria for Helicopter Instrument Flight

* * * * *

VIII. *Equipment, systems, and installation.* The basic equipment and installation must comply with §§ 29.1303, 29.1431, and 29.1433, with the following exceptions and additions:

* * * * *

(b) * * *

(5) * * *

(i) For pneumatic systems, only the required flight instruments for the first pilot may be connected to that operating system;

* * * * *

14. In appendix C to part 27 amend section “C27.2 Applicable part 29 sections” by removing “29.1309(b)(2) (i) and (d)—Equipment, systems, and installations” and by revising “29.903(b) (c) and (e)—Engines” to read as follows:

Appendix C to Part 27—Criteria for Category A

* * * * *

29.903 (b) and (c) —Engines.

* * * * *

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY

ROTORCRAFT

15. The authority citation for part 29 continues to read as follows:

Authority: 49 U.S.C. 106(f), 106(g), 40113, 44701-44702, 44704.

16. Amend § 29.955 by revising paragraph (a)(7) to read as follows:

§ 29.955 Fuel flow.

(a) * * *

(7) The fuel filter required by § 29.997 is blocked to the degree necessary to simulate the accumulation of fuel contamination required to activate the indicator required by § 29.1305(a)(18).

* * * * *

17. Amend § 29.977 by revising paragraphs (a)(1) and (2) to read as follows:

§ 29.977 Fuel tank outlet.

(a) * * *

(1) For reciprocating engine powered rotorcraft, have 8 to 16 meshes per inch; and

(2) For turbine engine powered rotorcraft, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

* * * * *

18. Amend § 29.1019 by revising paragraph (a)(5) to read as follows:

§ 29.1019 Oil strainer or filter.

(a) * * *

(5) An oil strainer or filter that has no bypass, except one that is installed at an oil tank outlet, must have a means to connect it to the warning system required in § 29.1305(a)(19).

* * * * *

19. Amend § 29.1305 by revising paragraphs (a)(5), (11), and (12) and adding (b)(4) to read as follows:

§ 29.1305 Powerplant instruments.

* * * * *

(a) * * *

(5) A means to indicate manifold pressure for each altitude engine;

* * * * *

(11) A means to indicate the gas temperature for each turbine engine;

(12) A means to indicate the gas producer speed for each turbine engine;

* * * * *

(b) * * *

(4) For each Category A rotorcraft for which OEI Training Mode is requested, a means must be provided to indicate to the pilot the simulation of an engine failure, the annunciation of that simulation, and a representation of the OEI power being provided.

* * * * *

20. Revise § 29.1309 to read as follows:

§ 29.1309 Equipment, systems, and installations.

The equipment, systems, and installations whose functioning is required by this subchapter must be designed and installed to ensure that they perform their intended functions under any foreseeable operating condition. For any item of equipment or system whose failure has not been specifically addressed by another requirement in this chapter, the following requirements also apply:

(a) The design of each item of equipment, system, and installation must be analyzed separately and in relation to other rotorcraft systems and installations to determine and identify any failure that would affect the capability of the rotorcraft or the ability of the crew to perform their duties in all operating conditions.

(b) Each item of equipment, system, and installation must be designed and installed so that:

(1) The occurrence of any catastrophic failure condition is extremely improbable;
(2) The occurrence of any major failure condition is no more than improbable; and
(3) For the occurrence of any other failure condition in between major and catastrophic, the probability of the failure condition must be inversely proportional to its consequences.

(c) A means to alert the crew in the event of a failure must be provided when an unsafe system operating condition exists and to enable them to take corrective action. Systems, controls,

and associated monitoring and crew alerting means must be designed to minimize crew errors that could create additional hazards.

(d) Compliance with the requirements of this section must be shown by analysis and, where necessary, by ground, flight, or simulator tests. The analysis must account for:

(1) Possible modes of failure, including malfunctions and misleading data and input from external sources;

(2) The effect of multiple failures and latent failures;

(3) The resulting effects on the rotorcraft and occupants, considering the stage of flight and operating conditions; and

(4) The crew alerting cues and the corrective action required.

21. Amend § 29.1329 by revising the section heading, adding introductory text, and revising paragraphs (a), (d), and (e) to read as follows:

§ 29.1329 Automatic pilot and flight guidance system.

For the purpose of this subpart, an automatic pilot and flight guidance system may consist of an autopilot, flight director, or a component that interacts with stability augmentation or trim.

(a) Each automatic pilot and flight guidance system must be designed so that it:

(1) Can be overpowered by one pilot to allow control of the rotorcraft;

(2) Provides a means to disengage the system, or any malfunctioning component of the system, by each pilot to prevent it from interfering with the control of the rotorcraft; and

(3) Provides a means to indicate to the flight crew its current mode of operation. Selector switch position is not acceptable as a means of indication.

* * * * *

(d) The system must be designed so that, within the range of adjustment available to the pilot, it cannot produce hazardous loads on the rotorcraft, or create hazardous deviations in the flight path, under any flight condition appropriate to its use or in the event of a malfunction, assuming that corrective action begins within a reasonable period of time.

(e) If the automatic pilot and flight guidance system integrates signals from auxiliary controls or furnishes signals for operation of other equipment, there must be a means to prevent improper operation.

* * * * *

22. Amend § 29.1333 by revising paragraph (a) to read as follows:

§ 29.1333 Instrument systems.

* * * * *

(a) For pneumatic systems, only the required flight instruments for the first pilot may be connected to that operating system.

* * * * *

§ 29.1335 [Removed]

23. Remove § 29.1335.

24. Amend § 29.1351 by adding paragraphs (e) and (f) to read as follows:

§ 29.1351 General.

* * * * *

(e) Electrical equipment, controls, and wiring must be installed so that operation of any one unit or system of units will not adversely affect the simultaneous operation of any other electrical unit or system essential to safe operation.

(f) Cables must be grouped, routed, and spaced so that damage to essential circuits will be minimized if there are faults in heavy current-carrying cables.

25. Revise § 29.1353 to read as follows:

§ 29.1353 Energy storage systems.

Energy storage systems must be designed and installed as follows:

(a) Energy storage systems must provide automatic protective features for any conditions that could prevent continued safe flight and landing.

(b) Energy storage systems must not emit any flammable, explosive, or toxic gases, smoke, or fluids that could accumulate in hazardous quantities within the rotorcraft.

(c) Corrosive fluids or gases that escape from the system must not damage surrounding structures, adjacent equipment, or systems necessary for continued safe flight and landing.

(d) The maximum amount of heat and pressure that can be generated during any operation or under any failure condition of the energy storage system or its individual components must not result in any hazardous effect on rotorcraft structure, equipment, or systems necessary for continued safe flight and landing.

(e) Energy storage system installations required for continued safe flight and landing of the rotorcraft must have monitoring features and a means to indicate to the pilot the status of all critical system parameters.

26. Amend § 29.1517 by revising the section heading to read as follows:

§ 29.1517 Limiting height-velocity envelope.

* * * * *

27. Amend § 29.1545 by revising paragraph (b) to read as follows:

§ 29.1545 Airspeed indicator.

* * * * *

(b) The following markings must be made:

(1) A red line:

(i) For rotorcraft other than helicopters, at V_{NE} .

(ii) For helicopters, at V_{NE} (power-on).

(iii) For helicopters, at V_{NE} (power-off). If V_{NE} (power-off) is less than V_{NE} (power-on) and both are simultaneously displayed, the red line at V_{NE} (power-off) must be clearly distinguishable from the red line at V_{NE} (power-on).

(2) [Reserved]

(3) For the caution range, a yellow range.

(4) For the normal operating range, a green or unmarked range.

* * * * *

28. Amend § 29.1549 by revising paragraphs (a) through (d) to read as follows:

§ 29.1549 Powerplant instruments.

* * * * *

(a) Each maximum and, if applicable, minimum safe operating limit must be marked with a red line;

(b) Each normal operating range must be marked as a green or unmarked range;

(c) Each takeoff and precautionary range must be marked with a yellow range or yellow line;

(d) Each engine or rotor range that is restricted because of excessive vibration stresses must be marked with red ranges or red lines; and

* * * * *

29. Amend § 29.1555 by revising paragraph (c)(1) to read as follows:

§ 29.1555 Control markings.

* * * * *

(c) * * *

(1) For fuel systems having no selector controls, the usable fuel capacity of the system must be indicated at the fuel quantity indicator unless it is:

(i) Provided by another system or equipment readily accessible to the pilot; and

(ii) Contained in the limitations section of the rotorcraft flight manual.

* * * * *

30. Amend § 29.1587 by revising paragraph (b)(6) to read as follows:

§ 29.1587 Performance information.

* * * * *

(b) * * *

(6) The height-velocity envelope except for rotorcraft incorporating this as an operating limitation;

* * * * *

31. Amend appendix B to part 29 by revising paragraphs VIII introductory text and VIII(b)(5)(i) to read as follows:

Appendix B to Part 29 -- Airworthiness Criteria for Helicopter Instrument Flight

* * * * *

VIII. *Equipment, systems, and installation.* The basic equipment and installation must comply with §§ 29.1303, 29.1431, and 29.1433, with the following exceptions and additions:

* * * * *

(b) * * *

(5) * * *

(i) For pneumatic systems, only the required flight instruments for the first pilot may be connected to that operating system;

* * * * *

Issued in Washington, DC, on or about February 6, 2023.

Billy Nolen
Acting Administrator

[FR Doc. 2023-02771 Filed: 2/9/2023 8:45 am; Publication Date: 2/10/2023]